In the Specification

Kindly replace paragraphs [0001] through [0002] with the following:

~~Description~~

Voltaic element

Related Application

This is a §371 of International Application No. PCT/EP2004/014332, with an international filing date of December 16, 2004 (WO 2005/060024 A2, published June 30, 2005), which is based on German Patent Application No. DE 103 61 360.9, filed December 18, 2003.

Technical Field

The subject matter of the invention is a voltaic element comprising at least one lithium intercalating electrode and a housing ~~consisting of~~comprising flexible film material through which diverters connected to the positive and negative electrodes of the element are conducted to the exterior.

Background

Rechargeable lithium cells with a flexible film housing (soft pack) are increasingly used in portable high-tech devices such as mobile telephones, PDAs and organizers due to their high energy density and the resultant low weight.

Kindly replace paragraphs [0006] through [0012] with the following:

~~Document~~ EP 1 291 934 A2 describes a cell in soft pack which can be highly stressed mechanically. The diverter material mentioned is, for example, aluminum, copper, phosphorous bronze, nickel, titanium, iron and refined steel and alloys of these. Furthermore, a possible following "soft annealing" is mentioned and possible coating of the diverters with a polymer, a phosphate compound, a titanium compound or a zinc phosphate for increasing the adhesion is described. As

can be seen from the examples, nickel is preferably used as the material for the negative diverter.

~~The document~~ US 6,045,946 discloses lithium polymer cells with a soft pack housing which has diverters of nickel-plated steel, aluminum foil or copper foil leading to the exterior.

~~The printed document~~ EP 1 276 161 A1 describes a corrosion-resistant coating for diverters of a lithium ion cell in soft pack which consists of phosphate/chromate etc. The material proposed for the diverters is aluminum, nickel, refined steel and copper.

~~The invention is based on the object of specifying~~It could accordingly be advantageous to provide a voltaic element of the type initially mentioned which has a very low overall resistance and is thus particularly suitable for high pulse loading.

Summary

~~According to the invention, this object is achieved by a voltaic element having the features of claim 1 or of claim 2. Advantageous and preferred embodiments of the invention can be found in the subclaims.~~This invention relates to a voltaic element including at least one lithium intercalating electrode and a housing including flexible film material through which diverters connected to positive and negative electrodes of the element and connected to safety electronics are conducted exteriorly, wherein at least one of the diverters which connect element and safety electronics includes nickel-coated copper foil.

Brief Description of the Drawing

Fig~~ure~~. 1 shows ~~the~~a diagrammatic structure of a lithium polymer cell in stacked technology, which is provided with safety electronics.

Fig. 2 is a graph showing the voltage variation of cells according to the prior art in comparison with cells constructed according to the invention with a discharge of GSM pulses (discharged: GSM/20°C (up to 3.0 V) GSM pulse loading: 2 A/0.55 ms; 80 mA/4.05 ms).

Detailed Description

~~The~~Fig. 1 shows positive collectors 3 of the stacked electrodes 1 ~~are~~ welded to the positive diverter 5. The negative collectors 2 are welded to the negative diverter 4. The diverters 4, 5 of the cell are welded to the corresponding diverters 6, 7 of the safety electronics 8.

Kindly replace paragraph [0014] with the following:

In the diverter 4, ~~consisting of~~which includes nickel-plated copper ~~according to the invention~~, the positive characteristics of two materials are combined in such a manner that the negative characteristics of the individual materials are eliminated; namely the electrically highly conductive copper is provided with a thin corrosion-resistant electrolyte-resistant easily weldable layer of nickel. The copper provides good electrical conductivity; the surface nickel-plating ensures that all other requirements such as corrosion-resistance, electrolyte-resistance and weldability are met.

Kindly replace paragraphs [0016] through [0017] with the following:

The combination of materials we used ~~according to the invention~~ is electrically more conductive, but at the same time easily weldable or solderable and corrosion-resistant. This material can be easily connected to the collectors of the negative electrode(s), which consist of copper in most cases, by means of ultrasonic or resistance welding. This material, which can come into contact with electrolyte in the interior of the cell, is resistant to the electrolyte used in each case and electrochemically compatible with the overall system.

The copper is preferably coated with nickel in a voltaic process, but can also be coated by means of a physical or chemical vapor deposition process. It is also possible to use a trimetal film with the sequence nickel-copper-nickel.

Kindly replace paragraph [0021] with the following:

Due to the high energy density and because of the inflammable and etching organic lithium electrolyte used, special safety precautions ~~must be taken~~are recommended with Li cells (Li ion and Li polymer) so that the end user is not endangered even with inexpert handling of the cell.

Kindly replace paragraphs [0023] through [0025] with the following:

~~This safety~~Safety electronics 8 also has diverters 6, 7 which are electrically conductively connected to the diverters 4, 5 of the cell by welding or soldering. If necessary, a temperature-dependent resistor (PTC, so-called "polyswitch") is additionally connected between safety electronics and cell. This is also electrically connected to a diverter of the cell and the safety electronics via additional diverters. These diverters, too, ~~consist according to the invention~~are made of nickel-plated copper.

Such circuit arrangements can be found in ~~the documents~~ DE 101 04 981 A1 and DE 102 50 857 A1.

Depending on the type of cell and type of link-up of the safety electronics and possibly of the temperature-dependent resistor (PTC), considerable improvements in the total resistance can be achieved by replacing the known nickel diverters with nickel-plated copper diverters having the same dimensions, namely a reduction in the resistance by 12% for a single cell, a reduction by 9% for a battery pack with an individual cell according to the prior art and link-up according to ~~the~~aspects of this invention of the safety electronics, and a reduction by 13% for a battery pack with a single cell according to ~~the~~aspects of this invention and link-up according to ~~the~~aspects of this invention of the safety electronics.

Kindly replace paragraphs [0032] through [0033] with the following:

According to the prior art (nickel diverter at the anode), such a cell has an internal resistance of

$$27 + 4.49\ m\Omega = 31.49\ m\Omega.$$

According to ~~the invention~~our structures (nickel-plated copper diverter at the anode), such ~~as~~ a cell has an internal resistance of

$$27 + 0.84\ m\Omega = 27.84\ m\Omega.$$

This results in an improvement of the resistance of the pure cell of 11.6%.

Example 2:

Single cell with safety electronics according to the prior art or single cell according to the prior art and link-up according to ~~the~~aspects of this invention of the safety electronics.

Kindly replace paragraph [0043] with the following:

Example 3:

Battery pack with single cell and electronics link-up according to the prior art or single cell and electronics link-up according to ~~the~~aspects of this invention, respectively.

Kindly replace paragraph [0050] with the following:

This battery pack

[[-]] has an internal resistance of

$$31.49\ m\Omega + 5.78\ m\Omega + 5.78\ m\Omega + 40\ m\Omega + 20\ m\Omega = 103.05\ m\Omega$$ (cell + diverter for electronics and PTC + safety electronics + PTC)

according to the prior art (nickel diverters at the anode and for electronics link-up) and

[[-]] has an internal resistance of

27.84 mΩ + 1.08 mΩ + 1.08 mΩ + 40 mΩ + 20 mΩ = 90 mΩ (cell + diverter for electronics and PTC + safety electronics + PTC)

according to ~~the~~aspects of this invention (nickel-plated copper diverters at the anode and for electronics link-up).

Kindly replace paragraph [0053] with the following:

Fig~~ure~~. 2 shows by way of example the voltage variation of cells according to the prior art in comparison with cells constructed according to ~~the~~aspects of this invention with a discharge of GSM pulses (discharged: GSM/20°C (up to 3.0 V) GSM pulse loading: 2 A/0.55 ms; 80 mA/4.05 ms).

Kindly replace paragraphs [0055] through [0056] with the following:

Uo2, Uu2 and ΔU2 analogously show the corresponding variation in cells according to ~~the~~aspects of this invention.

The improvement in performance and load-carrying capability of the cells according to ~~the~~aspects of this invention can be clearly seen. A considerable improvement in the device run time can be achieved in dependence on the load-specific turn-off voltage.